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CANADIAN PV COMMERCIAL ACTIVITY REPORT FOR 1989

PREPARED FOR:

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TABLE OF CONTENTS

EXECUTIVE SUMMARY ..... - i -

SOMMAIRE ..... - iv -

I. INTRODUCTION ..... - 1 -

II. OBJECTIVES AND METHODOLOGY ..... - 2 -
- A. Objectives ..... - 2 -
- B. Planning ..... - 2 -
- C. Distribution ..... - 2 -
- D. Collecting Responses ..... - 3 -
- E. Tabulating Responses ..... - 3 -
- F. Analysis of Results ..... - 3 -

III. INDUSTRY RESPONSE ..... - 4 -
- A. Initial ..... - 4 -
- B. Final ..... - 4 -
- C. Non-Respondents ..... - 5 -

IV. COMMERCIAL ACTIVITY FINDINGS ..... - 6 -
- A. Industry Activity Profile ..... - 6 -
- B. Overall ..... - 8 -
- C. Domestic ..... - 14 -
- E. Export ..... - 16 -

V. FINDINGS OF QUALITATIVE SURVEY ..... - 17 -
- A. Market Trends ..... - 17 -
- B. Important Issues ..... - 17 -

VI. INTERNATIONAL MARKET REVIEW ..... - 18 -
- A. Market Size and Growth ..... - 18 -

VII. CONCLUSIONS AND RECOMMENDATIONS ..... - 22 -
- A. Comparison With Previous Peat Marwick Report - 22 -
  - 1. Industry Activity Profile Changes ..... - 22 -
  - 2. Commercial Activity Growth ..... - 22 -
- B. Responders' Suggestions for Government Activity - 23 -
- C. Recommendations For Future Surveys ..... - 23 -

VIII. References ..... - 25 -

APPENDICES
- Appendix A: List of Participants Surveyed
- Appendix B: Copy of Questionnaire
- Appendix C: Peat Marwick Comparison Report 1988/1989
- Appendix D: Qualitative Responses

LIST OF TABLES

TABLE 4.1 GEOGRAPHIC LOCATION OF PV FIRMS SURVEYED . . - 6 -
TABLE 4.2 ACTIVITY PROFILE OF PHOTOVOLTAIC FIRMS . . . - 7 -
TABLE 4.3 DISTRIBUTION OF ANNUAL REPORTED SALES ACTIVITY IN PEAK WATTS BY APPLICATION (Domestic and Export) IN THE CANADIAN PHOTOVOLTAIC MARKET 1989 . . . . - 8 -
TABLE 4.4 REVENUES FOR BOS COMPONENTS . . . . . - 9 -
TABLE 4.5 DISTRIBUTION OF ANNUAL REVENUES FOR BOS COMPONENT SALES BY APPLICATION . . . . . - 10 -
TABLE 4.6 SUMMARY OF REPORTED SALES . . . . . - 12 -
TABLE 4.7 BREAKDOWN OF REPORTED SALES BY SOURCE/DESTINATION . . . . . - 13 -
TABLE 4.8 REGIONAL DISTRIBUTION OF SALES REPORTED FOR INSTALLATION IN CANADA . . . . - 14 -
TABLE 4.9 DISTRIBUTION BY PURCHASER TYPE FOR REPORTED SALES OF PV EQUIPMENT FOR INSTALLATION IN CANADA 15 -
TABLE 6.1 ANNUAL PV MODULE SALES IN MWp . . . . . - 18 -
TABLE 6.2 BREAKDOWN OF 1989 WORLDWIDE MODULE MFG. ACTIVITY (MWp) . . . . . - 19 -

CANADIAN PV COMMERCIAL ACTIVITY REPORT 1989

EXECUTIVE SUMMARY

The Canadian Photovoltaic Industries Association (C.P.I.A.) has conducted a mail survey amongst 65 Canadian firms involved in the photovoltaic industry and technology in order to determine commercial activity for the year 1989.

Overall revenue for these PV firms in the 1989 year is estimated to have increased almost 15% to a level in the range of 15 million dollars for Canadian PV commercial activity. This is an estimate based on responses received from 27 respondents of which 20 reported dollar sales in some detail. Distinction is made in the report between the actual numbers reported and any extrapolations or estimates of the figures as used.

The total of all sales reported for all applications and components was $9,300,725. Actual reported sales of modules totalled 400kWp for use in Canada and abroad. Communication applications consumed approximately 40% of these reported sales.

Export sales were significant with 59% of the reported system dollar sales ie. modules, structures, batteries, and controls sold as a package being exported. Another 14% of the system sales were imported and then re-exported. Conversely 22% of the system sales were manufactured abroad and imported for installation in Canada.

Sales of systems within Canada were reported fairly evenly distributed between Quebec, Ontario, the Prairies and British Columbia with 23% each. Module sales on the other hand were about equal in British Columbia and Ontario around 30% each and the Prairies and Quebec about the same at 17% of reported sales each.

British Columbia had the highest percentage of reported national balance of system (BOS) component sales at 40%.

The private sector share of the reported sales for installation in Canada was 42% or greater, in terms of both dollar or peak watt sales for systems and BOS components. Federal government purchases were 27 % of the individual modules dollar sales, but only 22% of the overall total reported PV sales. The private sector absorbed 60% of total of identified peak watts installed in

Canada with 140 kWp of the 211 kWp reported in this market.

The "residential use" and "water pumping" segments of the market reported increased activity and have become major sectors with 223 residential systems and 126 water pumping systems reported. A total of 881 systems for all segments was reported in the responses. Total sales by the responders of 397 kilowatt peak were reported in the survey.

Several major changes occurred within the industry sector during 1989 with TPK International and Westronics leaving the PV industry. A number of new firms were reporting for the first time in this survey. The total sales reported for these new entrants were a significant 5.3 million dollars in 1989.

Internationally, annual PV module sales in 1989 were reported to be 42 megawatt peak, a 20% increase from 35 megawatt peak in 1988. The United States leads the world market share with 36%, while Japan follows with 30%, and Europe with 20%.

New global production capacity announced during the year totalled approximately 100 megawatt peak by various firms indicating strong worldwide confidence in the technology.

Strong market demand saw module prices stabilize and increases reported by some manufacturers.

The PV USA project in California reported contracts in place for a total of 967 kilowatt peak including a number for emerging module technologies of copper indium diselenide (CIS), polycrystalline silicon on ceramic, and cadmium sulfide/cadmium telluride (CdS/CdT) devices.

A number of major projects were reported including a one megawatt residential PV program for roof top system in Switzerland, and a large aid program for West Africa by the European Community which would include over 1000 water pumping systems.

Continued steady development in research laboratories produced a new record breaking efficiency level of 23.2 % for mono crystalline silicon one sun devices and an impressive 37% for high concentration, concentrator cells.

Recommendations are given for continuing the annual PV Commercial Activity Survey but with detailed questionnaires being utilized only every 3 years.

Intermediate years would see only basic total figures requested in order to encourage more extensive participation by the industry firms .

Respondents have made suggestions for a more equitable tax treatment by the governments on PV products and more extensive use by government agencies of the technology.

Environmental issues including the green house effect on global warming are seen as having a major impact on the marketing strategies of some of the respondent firm to take advantage of PV's attributes.

Concern was also expressed over oil prices and instability of the Mid East with the resultant impact on the competitive nature of the fossil fueled generator sets with which PV competes.

SOMMAIRE

L'Association des industries photovoltaïques du Canada a effectué un sondage postal auprès de 65 entreprises canadiennes qui oeuvrent dans le domaine photovoltaïque, afin de mesurer leur activité commerciale en 1989.

On estime qu'en 1989, les recettes cumulatives de ces entreprises de PV ont augmenté de près de 15 % pour atteindre un chiffre d'affaires de l'ordre de 15 millions de dollars. Cette estimation est établie d'après les questionnaires retournés par 27 répondants, dont 20 ont fourni des détails sur leur chiffre des ventes. Une distinction est faite dans le rapport entre les chiffres déclarés par les répondants et les extrapolations ou estimations établies à partir de ces chiffres.

Le chiffre d'affaires total déclaré, toutes applications et composantes confondues, s'élève à 9 300 725 $. Le volume total, en puissance de crête, des ventes déclarées de modules à utiliser au Canada et à l'étranger s'est chiffré à 400 kWc. Environ 40 % de ces ventes étaient destinées au secteur des communications.

Les exportations sont considérables et représentent 59 % du chiffre d'affaires découlant de la vente de systèmes (c.-à-d. modules, structures, batteries et organes de contrôle réunis). Quatorze pour cent (14 %) des systèmes ont été importés pour être ensuite réexportés. Par ailleurs, 22 % des systèmes ont été fabriqués à l'étranger et importés pour usage au Canada.

Les ventes de systèmes au Canada sont réparties assez uniformément entre le Québec, l'Ontario, les Prairies et la Colombie-Britannique (23 % chacun). Pour ce qui est des modules, la Colombie-Britannique et l'Ontario représentent chacune environ 30 % du chiffre d'affaires, les Prairies et le Québec 17 %.

C'est la Colombie-Britannique qui a déclaré le plus fort pourcentage de ventes de composantes résiduelles (appelées BOS pour «balance of system») au pays, avec 40 %.

La part du secteur privé dans les ventes déclarées de systèmes et de composantes BOS, exprimées en chiffre d'affaires ou en puissance de crête, pour usage au Canada est de 42 % ou plus. Les achats du gouvernement fédéral ont représenté 27 % du chiffre des ventes de modules, mais seulement 22 % du chiffre total des ventes de systèmes. Le secteur privé a absorbé 60 % de la puissance de crête totale installée au Canada, avec 140 kWc des 211 kWc déclarés sur ce marché.

Les ventes de systèmes destinés aux usages résidentiels et au pompage de l'eau ont augmenté de façon appréciable; les répondants ont déclaré 223 stations résidentielles et 126 stations de pompage d'eau. Le nombre total de systèmes déclarés dans les réponses, toutes applications confondues, est de 881. Les ventes totales déclarées se chiffrent à 397 kWc.

Plusieurs changements majeurs ont eu lieu dans l'industrie au cours de 1989. Entre autres, TPK International et Westronics ont abandonné l'industrie photovoltaïque. Par contre, de nouvelles entreprises ont participé pour la première fois à ce sondage. Le chiffre d'affaires total de ces nouvelles venues dans l'industrie a été de 5,3 millions de dollars en 1989, ce qui est appréciable.

Sur la scène internationale, les ventes déclarées de modules PV ont été de 42 MWc en 1989, en hausse de 20 % par rapport à l'année précédente (35 MWc). Les États-Unis ont 36 % du marché; ils sont suivis du Japon, avec 30 %, et de l'Europe, avec 20 %.

Diverses entreprises ont annoncé durant l'année une nouvelle capacité de production totalisant 100 MWc, ce qui témoigne d'une grande confiance mondiale à l'égard de la technologie PV.

Devant une forte demande, les prix des modules se sont stabilisés, et certains fabricants ont annoncé des majorations.

Dans le cadre du projet PV USA en Californie, des contrats ont été passés pour un total de 967 kWc, comprenant de nouvelles technologies de fabrication de modules : séléniure double d'indium et de cuivre (CIS), silicium polycristallin sur céramique et sulfure de cadmium/tellurure de cadmium (CdS/CdT).

Les répondants ont fait état d'un certain nombre de projets importants, notamment un programme d'installation de stations PV sur les toitures des maisons (pour une puissance totale de 1 MW) en Suisse, et un vaste programme d'aide de la Communauté européenne à l'Afrique occidentale, qui comporterait l'installation de plus d'un millier de stations de pompage d'eau.

Les progrès qui se font constamment dans les laboratoires de recherches ont permis d'atteindre un rendement record de 23,2 % dans le cas des appareils à silicium monocristallin, et un rendement impressionnant de 37 % dans le cas d'un panneau solaire à forte concentration.

Les répondants recommandent que l'on poursuive l'examen annuel de l'activité commerciale de l'industrie photovoltaïque, mais en utilisant le questionnaire détaillé seulement tous les trois ans. Durant les années intermédiaires, on demanderait uniquement des données globales et des chiffres cumulatifs, de façon à encourager un plus grand nombre d'entreprises à participer au sondage.

Des répondants ont réclamé des gouvernements un traitement fiscal plus équitable des produits PV. Ils ont aussi demandé que les organismes publics fassent un usage plus répandu de la technologie.

Certaines entreprises répondantes attachent beaucoup d'importance

aux questions environnementales, comme l'effet de serre et le réchauffement planétaire, dans leurs stratégies de marketing, et font valoir les avantages de la technologie PV à cet égard.

Des répondants disent s'inquiéter des prix du pétrole et de la précarité de la situation au Moyen-Orient, qui influent sur la compétitivité des technologies de production d'électricité à énergies fossiles avec lesquelles la PV est en concurrence.

PV COMMERCIAL ACTIVITY IN CANADA REVIEW 1989

I. INTRODUCTION

The Canadian Photovoltaic Industry is a participant in a world wide rapidly growing industry that is seeing great changes annually in production technology, distribution chains, applications and market size. In order to identify the extent of the Canadian Industry, a survey was previously performed on the activities of PV firms in Canada by the accounting firm of Peat Marwick for the period 1985 to 1988 which culminated in their report "Analysis of Commercial Activity in Photovoltaics" in August 1989. Additionally the Canadian Photovoltaic Industries Association (CPIA) has prepared a Canadian Sourcing List for PV hardware to identify the members in the distribution chain for PV products in Canada.

As the activity in the industry over time is a measure of its growth, it can indicate the response to government assistance activities and programs in the technology. The Peat Marwick study provides a view of the commercial activity from 1985 through 1988 and has established a base period and status for future reference. While the previous report covered a three year period, this present report focuses on the year 1989.

The purpose of this project was to continue the gathering of information on a routine basis. This report regarding the commercial activity within Canada should serve the interest of both the industry and government in establishing the status of the market and its participants.

II. OBJECTIVES AND METHODOLOGY

A. Objectives

The objective of this work was to continue the investigation of the commercial PV activity in Canada initiated in the Peat Marwick report which covered the years 1985 to 1988. The time period covered by this report is the year 1989 and specifically the information was requested for the companies' activity in their fiscal year ending in 1989. Thus while some figures might actually reflect shipments in the latter part of 1988 if the fiscal year ended before Dec.31,1989, all future references to the period in this report will be 1989. This is consistent with the previous report and is not felt to be of consequence.

The intent was to identify the growth areas in the industry and the changing structure of the active participants in the photovoltaic industry in Canada. By including a section on the International Market, it was intended to put the developments within Canada into perspective with the global picture.

B. Planning

In order to maintain the continuity of results for comparative purposes, the planning group agreed that the general format of the questionnaire used in the previous survey would be used. To facilitate the response by the participants and to make the questionnaire less onerous, the break down by system size was omitted and a number of the forms were consolidated as only a one year time period was covered.

The question of confidentiality was paramount in the planning of the treatment of the responses and to this end the accounting firm of Peat Marwick was again engaged to receive and tabulate the responses.

C. Distribution

The distribution of the questionnaire was handled by the CPIA office to a list of approximately 65 potential respondents. The names utilized were obtained from the work done by the CPIA in identifying local sources of PV hardware in Canada during the preparation of the "PV Source List".

It is acknowledged that undoubtedly a number of other

outlets of PV equipment exist, however it was felt that most of the major outlets that are located in Canada were included.

It should be pointed out that the volume of direct purchases by individuals and companies from dealers or distributors in the U.S. or other foreign companies is most difficult to assess accurately when no Canadian distributor is involved. Another market segment which is difficult to assess is the utilization by users of conventional batteries purchased through conventional battery distributors not specializing in photovoltaic systems or equipment. It is also known that some major Canadian firms have supplied systems off shore and have sourced the batteries directly from the manufacturer and have not been included in our responses.

D. Collecting Responses

The responses were returned by mail to the Ottawa, Ontario office of Peat Marwick directly to insure confidentality in the sales figures. Return envelopes were provided for the respondents and the use of the independent accounting firm provided adequate assurance to the participants that the figures reported would be made available to no one outside the firm.

E. Tabulating Responses

The results of the returned questionnaires were tabulated in a data base of the same format utilized in the previous activity review. This work was performed by the same personnel of the same accounting firm. Only slight modifications were necessary in the data base to accomodate the changes in the new questionnaire. The main difficulty in tabulating the results was the decision as to when to terminate the follow up of the non responders and to initiate the compilation of the results.

F. Analysis of Results

The aggregate of the numerical results were provide by Peat Marwick and a preliminary analysis prepared for finalization by C.P.I.A.

In calculating total activity for 1989 in order to compare with the previous survey of 1988 a similar process of extra-polation was followed but only considering the same non respondents for both surveys. Of the (65 -27) 38 current non responders only 7 were involved in the previous report and these were the only ones considered in

addition to the 27 responders.

Readers are reminded when considering results, to distinguish between the "reported" figures, that are from those responding with actual figures, as opposed to the "estimated" figures which include an estimate for those firms not reporting actual figures.

The "estimated" figures are utilized only in the overall activity report and include extrapolations only for the twenty seven responders plus the seven non-responders to both the previous and current surveys.

Thus while the overall activity is estimated in the range of 14 million dollars, the total reported sales by respondents is indicated in table 4.6 as 9.3 million. The difference is the extrapolation for non-respondents and ancillary activity costs such as installation and unreported battery storage costs.

III. INDUSTRY RESPONSE

A. Initial

Questionnaires were mailed out to the prepared industry list which totaled 65 firms or individuals previously identified as having some involvement in the Photovoltaic Industry. This compares with a total of 22 firms circularized in the previous survey. Initial response was in the order of 25% within the first four weeks of mail out. There were a number of important participants that had not responded and a follow up program was instituted by phone and fax in order to obtain responses from all the respondents, but with the key non responders in particular. A second questionnaire was sent out to a number of firms which reported that they had misplaced the original package.

B. Final

The final response totaled 27 of the 65 firms on the original
list for a respectable response rate of 41.5% of the identified industry participants. While undoubtedly more responses would have been obtained with further follow up, it was felt that with the exception of several who refused to respond, that the majority of the important players were included in the responders. It is suggested

that firmer deadlines be established internally at least for the conduct of any future surveys, in order to provide a more timely response to the industry with the statistics. Appendix A provides a list of participants surveyed.

Of the 27 responders a total of 20 provided dollar amounts while others provided qualitative data.

C. Non Respondents

In general the significant participants in the industry co-operated and provided responses for the project, however there were a few who refused to respond on principle. The majority of non responders reported lack of time to complete the survey and lack of activity to make their responses pertinent.

The detail requested in the questionnaire undoubtedly is a deterrent in soliciting a prompt and ready response and while the detail is necessary for analysis purposes, a simpler form would elicit a better response for more basic data.

One option which could be considered would be a very basic questionnaire for totals only on an annual basis and then a more detailed survey similar to the current one every 3 years.

IV. COMMERCIAL ACTIVITY FINDINGS

A. Industry Activity Profile

A distribution of the firms across Canada by provinces along with the number of responses is indicated in Table 4.1 below.

Province	Questionnaires Sent	Responses Received
Newfoundland	1	0
Nova Scotia	3	1
Quebec	13	2
Ontario	26	12
Manitoba	2	1
Saskatchewan	2	1
Alberta	9	4
B.C.	9	6
TOTALS	65	27

Table 4.1 GEOGRAPHIC LOCATION OF PV FIRMS SURVEYED

In terms of how these firms were involved in Photovoltaic activity, the responses were solicited with regards to the following activities as being either a primary or secondary activity. This table is similar to Exhibit II-1 of the previous survey and a comparative listing for the 1988 survey is given in the totals column on the right hand side.

	Primary Activity		Secondary Activity		Primary or Secondary Activity 1989		1988	
	#	%	#	%	#	%	#	%
Manufacturing	5	21.7	6	26.1	11	47.8	5	45
Assembling	8	33.3	11	45.8	19	79.1	6	54
Distribution	8	42.1	4	21.1	12	63.2	8	72
Retailing	10	49.6	7	33	17	81	8	72
Wholesaling	6	28.6	7	33.3	13	61.9	7	63
Consulting	11	45.8	11	45.8	22	91.7	8	72
Installation	7	30.4	13	56.5		87	7	63
Other	2	7	3	11	5	18	5	45

*n = 27 firms 1989 (11 firms 1988), percentages do not add up to 100 because of multiple responses, i.e., each firm could have more than one primary and one secondary activity.

Table 4.2 ACTIVITY PROFILE OF PHOTOVOLTAIC FIRMS

According to the above responses most firms responding are involved in consulting activities (91.7%) and installation activities (87 %).

Distribution and wholesaling are down only slightly, while almost half indicate that they are involved in manufacturing activities (47.8%). A greater percentage of respondents are also now involved in retailing up from 72% to 81%.

In terms of overall activity, the Peat Marwick report in Section VII A indicates an increase of revenues between 88 and 89 of almost 15 % with total revenues in the 15 million dollar range.

Two major changes in the industry worthy of note in 1989 that will have an undefined effect on the results of the survey are the demise of T.P.K. International, the subsequent establishment of AstroPower Canada, and the revitalization of Darentek Corporation. The other item is the

dropping of the ARCO distribution franchise by Westronic Industries of Calgary and the establishment of Reonac as eastern distributor and Soltek as western distributor for the ARCO products. These are now Siemens Solar distributors following the 1990 sale of Arco Solar to Siemens.

B. Overall

The distribution of annual sales activity by application as reported by the responders is summarized in the following table 4.3

APPLICATIONS	% PEAK WATTS	REPORTED Wp
Communications	41.3	164,028
Monitoring/Sensing	1.5	5,826
Water pumping	20.0	79,756
Residential/Remote Lighting	32.6	129,233
Retail and Other	1.8	6,964
Not Specified	2.9	11,400
TOTALS	100.0	397,207

* n = 20. Percent of Total Wp(Peak Watts) reported over all applications for modules in and outside complete systems packages. The percentage distribution is based on the responses received.

TABLE 4.3
DISTRIBUTION OF ANNUAL REPORTED SALES ACTIVITY IN PEAK WATTS BY APPLICATION (Domestic and Export) IN THE CANADIAN PHOTOVOLTAIC MARKET 1989

It should be emphasized that the figures shown in the tables 4.3 to 4.9 are those figure reported by the respondents as actual sales and do not include any estimates for non responders.

It is seen that the major application is still communications at 41% but the residential and remote lighting sector is a very strong second with 32.6% of the reported sales.

It should be noted that the above percentages are based on the reported Peak Watts not dollar sales and represent only those responses where a breakdown was provided.

Table 4.4 reports the breakdown of revenues for balance of system (BOS) components as reported for four major applications.

	Batteries		Power Conditioning		Other		Total
	1989	1988	1989	1988	1989	1988	1989/1988
Communications	63%	25%	35%	51.4%	1.5%	23.6%	100%
Monitoring	39%	57.1%	40%	42.9%	20%	-	100%
Residential	28%	22.7%	59%	48.5%	12%	28.8%	100%
Water Pumping	33%	35.3%	33%	64.7%	33%	-	100%

*n = 20, data for year 1988-1989
= 11, data for year 1987-1988

TABLE 4.4
REVENUES FOR BOS COMPONENTS

A major difference is seen in the percentage of revenues for batteries in communication applications which would probably reflect a change in the scope of supply for the firms as opposed to a basic change in system design.

Table 4.5 breaks down the reported revenues for the various balance of systems components by applications as reported.

	Batteries		Power Conditioning		Other Equipment	
	1989	1988	1989	1988	1989	1988
I. % of those reported by application						
Communications	17%	20%	12%	13.5%	1%	8%
Monitoring/ Sensing	<1 %	4%	<1%	1.4%	.8%	-
Water Pumping	<.5%	8%	15%	4%	1%	-
Residential/ Remote Lighting	23%	40%	67%	25.7%	23%	38%
Retail & Other	35.%	28%	1.5	55.4%	1.4	54%
Unidentified	24%		26%		72%	
REPORTED TOTAL	100%	100%	100%	100%	100%	100%

*n = 20, Data based on year 1989

TABLE 4.5
DISTRIBUTION OF ANNUAL REVENUES FOR BOS COMPONENT SALES BY APPLICATION

A number of interesting observations can be made from these data. In reviewing the recorded sales figures for systems, a total of 881 systems were reported with an average selling price of $26.79 per watt peak.

Sales of modules independent of systems averaged out at $9.06 per watt peak.

These are average figures from all types of systems and represent a nominal gauge for the industry only. They should not be construed as prices that will be quoted but can serve as a guide.

A summary of total sales including exports as reported, is given in Table 4.6 with a number of the sectors consolidated into the "other" category in order to maintain confidentiality where only two respondents provided figures for a segment. Unfortunately a complete break down is not available on all the responses and where this occurred, the figures reported have been included in the total only. The total of all sales reported by respondents is $9,300,725.

Corresponding data in detail were not available from the

previous surveys and no specific comparisons are possible at this time from these data. It is of significance, to note that the numbers of systems as reported, are indicating that the residential use of systems are now most predominant in the Canadian market as opposed to the communication systems and the marking/warning systems previously reported. In terms of dollar value and total watt peak for complete systems, communications segment is still the leader.

In module sales, communications again is the leader in the number of modules but residential use sector dollar value and peak watts surpasses the communications segment by a slight margin.

Conclusions for other components and groups are difficult because of the large percentage of data not broken down in the reports.

APPLICATIONS	A SYSTEMS			B MODULES			C B.O.S.		
	No. of Systems	$,000	Total kWp	No. of Modules	$,000	Total kWp	Batteries $,000	Power Cond. Equipt. $,000	other BOS $,00
Communications	193	4117.2	116.3	824	426.4	47.7	76.9	41.9	2.
Monitor/Sensor	115	104.0	4.6	149	64.5	1.2			
Residential Use	223	202.1	40.5	752	429.3	49.5	76.5	203.9	46.
Laboratory Test									
Retail/Corrosion Protection									
Remote Lighting				613	268.1	35.6			
Water Pumping	126	1489.8	78.9						
Community Power									
Medium Load Centre Indust/Commerc									
Residential Grid Connect	2								
Other	222	362.2	4.1	422	43.3	7.4	196.3	31.0	6.
TOTAL (all applications)	881	6874.3	244.5	2960	1384.6	152.7	469.7	376.7	195.

Note: The sum of the columns does not necessarily add to the "Total (all applications)" as some respondents only provided total sales data.

TABLE 4.6 SUMMARY OF REPORTED SALES
(including exports)

CATEGORIES		Reported Sales and Percentages		
		A Systems	B Modules	C BOS Comp
Manufactured in Canada	$	319,870	N/A	18541
and installed in Canada	%	4.6		4.9
Manufactured in Canada	$	4,061,777	N/A	1061
and installed abroad	%	59		0.3
Manufactured Abroad	$	1,539,548	N/A	305,771
and installed in Canada	%	22.4		81.4
Imported and re-exported	$	953,130	304,242	50,070
	%	13.9	22	13.3
TOTAL IDENTIFIED 1989	$	6,874,325	1,379,968	375,442
TOTAL %		100	100	100
UNIDENTIFIED	$	0	4,632	666,358
TOTAL REPORTED SALES	$	6,874,325	1,384,600	1,041,800

N/A - not available in order to maintain confidentiality

TABLE 4.7 BREAKDOWN OF REPORTED SALES BY SOURCE/DESTINATION

C. Domestic

The following tables present the data reported for sales for use in Canada as opposed to sales destined for the offshore or export market.

The total of the reported sales for installation in Canada is $4,698,861 and these are broken down by Regional Distribution in Table 4.8 and by Type of Purchaser in Table 4.9. This total of domestic sales is approximately 50% of the total reported for export and domestic installations.

REGION	REPORTED SALES BY SECTION - $ AND %					
	A.-Systems		B.-Modules		C. BOS	
	$	%	$	%	$	%
Atlantic	166,290	6	50,716	4	1,701	4
Quebec	671,300	23	235,195	17	21,245	6
Ontario	677,824	23	394,312	28	62,251	17
Prairies	631,852	22	242,059	17	82,612	22
Br. Columbia	544,841	19	430,380	30	152066	40
NW.Territories	87,919	3	38,539	3	28,161	7
Yukon	125,732	4	25,241	2	28,625	8
TOTAL	2,905,758	100	1,416,442	100	376661	99

Table 4.8 REGIONAL DISTRIBUTION OF SALES REPORTED FOR INSTALLATION IN CANADA

TYPE OF PURCHASER for installation in Canada	A SYSTEMS		B MODULES		C BOS COMPONENTS	D TOTAL	E TOTAL
	$,000	kWp	$,000	kWp	$,000	$,000	kWp
Federal	608.9	22.6	378.5	18.6	61.6	1049	41.2
Government %	20.9	18	27	21	16	22	19
Provincial	558.4	18.9	102.1	5.2	31.6	692.1	24.1
Government %	19.2	15	7	6	8	15	17
Utilities	263	2.7	40.5	3.3	70.6	374.1	6
%	9	2	3	3.6	18.7	8	9.1
Research	10		4.5		1.5	7	0
Educational %	.03		.3		.3	.3	
Private	1316	77.7	463.1	62.2	211.4	1990.5	139.9
Sector %	45	63.9	32.9	69.7	56.1	42	66
Unidentified$	149.5		427.7			586	
%	5		30			12	
TOTALS $,000	2,905.8		988.7		376.7	4,698.9	
%	100		100		100	100	
TOTALS kWp		121.9		89.3			211.2

TABLE 4.9 DISTRIBUTION BY PURCHASER TYPE FOR REPORTED SALES OF PV EQUIPMENT FOR INSTALLATION IN CANADA

E. Export

Canadian firms continue to export their PV equipment to a wide variety of countries through out the world. A quantitative breakdown of shipments is not available due to limited responses.

A list of the countries to which exports of assembled, distributed or manufactured PV Canadian goods were reported follows:

Africa	U.S.A.	Mexico
Bahamas	Jamaica	Belize
Lesotho	Barbados	Bolivia
Zimbabwe	Morocco	Netherlands
Yugoslavia	Sri Lanka	Spain
Spain	Caribbean	Ghana
Uganda	Ethiopia	Tunisia
Far East		

The total value of reported PV exports from Canada including equipment imported and re-exported is $5,325,280 as indicated in Table 4.7. This figure is approximately 50% of the total reported sales for both domestic and export.

V. FINDINGS OF QUALITATIVE SURVEY

A. Market Trends

From the activity profile of the Canadian firms reporting it appears that the majority of firms are involved in assembling, retailing, consulting and installing as part of their primary or secondary activities. The number of firms reporting in the retailing activity increased from eight to seventeen and the number of firms reporting activity in consulting increased from eight to twenty two. The number of consumer products now available from an increased number of sources, is a factor in explaining why the retailing of consumer products is also expanding rapidly as a market segment.

The number of reported systems sold indicates that the residential use of PV has become the leader in the number of reported systems installed, although not in dollar value nor total wattage. On the other hand with regard to loose modules sales reported, residential use is the leading market segment, with 49.5 kilowatt peak reported in 1989.

Water pumping has become a much larger percent of the market comprising roughly 32 % in 1989 as opposed to 4.9% in 1988 of peak watts sold.

B. Important Issues

A number of issues of concern were identified in the qualitative responses with environmental issues being a common thread in many.

Safety and Electrical Code implications were mentioned as it would appear that more firms were encountering these issues in their marketing programs.

The continuing need for educational efforts to the potential users was reflected in the comments of several new responders, that many people are completely unaware of PV'S availability and performance benefits.

Along with the environmental and green house effect issues, the availability and price of oil from the Mid East is seen as a major issue that will affect the PV markets.

Specific responses on these questions are included in appendix C.

VI. International Market Review

1. Market Size and Growth

For the first time in a number of years, activity in the 1989 PV market globally has been sufficiently high that the demand for modules has exceeded the production capacity.[1] Despite this attractive state of affairs, the industry as a whole is not yet profitable. A prime example is one of the most aggressive amorphous-si producers, Chronar which reported losses of $49,064,316.00 on revenues of $18,591,131.00[2]. Their estimated production of 600 kWp a-si in the US was significant in the US totals.

The overall global PV sales totals, continue a very respectable increase over the previous year in the range of 20% from 35MWp in 1988 to 42MWp in 1989. As the estimated sales for 1990 of 52 MWp[3] were achieved, the four year increase from 1986 to 1990 would be about 100%, averaging in excess of 20% growth per year. The total annual sales recorded are given in the following table for both Europe and the global community.

Year	Global[4]	Europe[5]
1986	26.1	4.2
1987	28.0	4.3
1988	35.0	6.4
1989	42	8.7

Table 6.1 ANNUAL PV MODULE SALES IN MWp

The figures for 1989 are broken down in the following table in terms of amorphous (a-si) and crystalline(c-si) products as well as country of manufacture and percent of world market share.

	OUTPUT (MWp)		WORLD MARKET SHARE	
United States	15.5		36.25%	
a-si		3.8		8.8%
c-si		11.7		27.3%
Japan	12.75		29.8%	
a-si		9.25		21.6%
c-si		3.5		8%
Europe	8.75		20.4%	
a-si		2.25		5%
c-si		6.5		15%
All others	5.75		13.5%	
a-si		.75		1.5%
c-si		5.75		12%
TOTALS	42.75		100%	
a-si		16.05		37.45%
c-si		27.45		64.21%

Table 6.2 Breakdown of 1989 Worldwide Module Mfg. Activity (MWp) [6]

One interesting item due to the increased activity has been the number of announcements by various firms to expand their PV production facilities. In total it appears that new capacity is planned of 100MWp+ [7].

A most significant event in Sept.89 was the reported sale of Arco Solar of California to the German multinational electrical firm Siemens [8]. They had previously worked together and Siemens-Arco just opened a new 1MWp facility [9] in Germany, at Bergish Gladbach for thin film production.

US exports were reported to be 47% of production in 1987 [10], the latest year with figures available.With the strong market demand, PV module prices were increased by the major manufacturers approximately 10% in an apparent effort to bring some profits to the manufacturing segment. This is seen as a sign of a maturing industry, but the impact will depend on the

position taken by major Japanese producers, whether or not they follow the lead in adjusting prices or continue to market at the previous levels.

2.National PV Support Programs

In the US, a manufacturers support program was announced to assist US PV manufacturers update and expand their production facilities over the next few years.

Continued development of the utility or grid connected potential was seen in the increased support by EPRI to the PVUSA program funding to a level of $500,000 [11]. The PVUSA is a major joint program in the US sponsored by the Department of Energy and others to install and research PV for Utility Scale Applications(PVUSA).

The PVUSA New Emerging Module Technology (EMT)-phase 2 saw 3 new contracts awarded [12] to Arco for 7.7% efficient CuIS, Astropower 8.3% Poly Si on ceramic, and Photon Energy, 6.2% CdS/CdT. This brings the total for contracts placed for PVUSA phases to 967 kWp total.[13]

In Japan a four year (1992) a-si plan was announced with targets of 12% efficiency for mini modules (10cm x10cm) and 10% for larger modules (30x30)[14].Italy reports 25MWp of PV planned by 1995.[15]

A.Major PV Projects

Switzerland - Alpha Real initiated a major 1 MWp Residential PV[16] program for 300 roof top systems of 3kWp termed "Project Megawatt".

Austin Texas project of 300kWp reported excellent operating experience with 99% availability[17]

A large aid program of PV systems called the Sahel Program by the European Community, ECC [18] was planned for west Africa to include the following:

1040 water pumping systems
139 cooling systems
462 lighting systems
89 battery charging systems

In Germany, a large utility, RWE installed a 340 kWp grid connected system at Kobern-Gondorf, W.Germany ,as the start of a planned total of 1MWp.

In the USA the HOPI Foundation initiated a large program to install PV on 356 native residences in Arizona.[19]

The dismantling and component sale of Hisperia and Carrisa Plains Arco projects was announced by new owners, much to the dismay of many in the industry as these were two of the largest PV systems installed to date. The break-up price on the market was apparently perceived to be worth more than the income being generated under the original contract with the utility.

Additionally some degradation of output was detected as a result of browning of the encapsulation, reportedly caused by excessive high temperatures when operating with the mirror enhanced reflectors. It was decided to sell the existing modules while still functional and possibly replace them with current technology when economically attractive.

D. Technology

While no "breakthrough" was announced during the 1989 year, both cell and module efficiencies continued steady improvement in the various commercial and research labs. Significant reports are listed below.

Eureka a-si 2.5ft by 5 ft. module 50.7 Wp - Chronar
Martin Green - c-si 18% poly, 23.2% mono[20]
Solec - 2Wp 5"sq.cell
Sandia - 20% module eff. @ 100 suns[21]
USA - trend towards larger capacity facilities to lower production costs[22]
- Ogden Williams report re PV/H2[23]
- point contact cell eff reaches 28.5%[24]
- Boeing GaAs/GaSb concentrator cell eff 37%[25]
- SERI 26% eff one sun GaInP2/GaAs[26]

Telefunken Systemtechnik Gmbh, Hamburg, W.Germany reports 18% eff si modules.[27]

VII. CONCLUSIONS AND RECOMMENDATIONS

A. Comparison With Previous Peat Marwick Report

1. Industry Activity Profile Changes

There has been a significant increase in the number of firms involved in the PV Industry within Canada as evidenced by the number of mailouts and responses. The responses received were more than doubled from eleven to twenty seven with responses from all provinces except Newfoundland, P.E.I., and New Brunswick.

A greater percentage of reporting firms are involved in consulting activities, most firms were also involved in installation activities as either a primary or secondary activity of the firm.

A wider geographical distribution is seen in the latest survey as opposed to only 4 provinces being included in the previous (1988) review.

Unfortunately due to the lack of availability of complete response data from the previous survey, broader comparisons are difficult to make at this time. It is expected that future surveys will be able to build on the data now in hand, and will be able to develop more detailed changes and trends.

Major changes in the industry occurred in 1989 with 2 key players, TPK and Westronic leaving the industry, with other firms such as Intelcan and AstroPower have entered and assumed major status.

2. Commercial Activity Growth

As the accounting firm that received the responses were responsible previously for estimating the total sales activity, it was felt that the best comparison could be made by utilizing the same firm to make similar estimates of the results for the current survey of the year 1989. A copy of their report in this regard is enclosed in Appendix C which indicates that the Canadian PV Industry increased its revenues in 1989 over the previous year by approximately 15%, with the total revenues in the fifteen million dollar range.

The total of the sales reported by survey respondents is $9,300,725 with the difference being the estimate of activity by non-respondents, those responding without figures, and those not covered in the survey. Thus the increase in reported activity was $1.9 million and without considering the estimates for non responders, this represents an increase of more than 15% from the previous year.

As indicated in their report, the estimate for non-responders was the same in both periods.

Combined revenues in 1989 of only those companies that responded to both the previous and current surveys in total was 3.4 million less then in the initial one. New participants in the 1989 survey however, reported revenues of approximately 5.3 million in 1989 which confirms the presence of new major players in the Canadian industry.

B. Responders Suggestions for Government Activity

As could be expected a number of respondents made suggestions regarding government funding support for R and D demonstration projects along with a plea for removal of taxes on PV products.

Support was requested specifically for deployment of PV hybrid power systems for remote communities and for the production of solar grade silicon within Canada.

Additionally it was felt the Federal Government should encourage the industry by developing policies to increase the use of PV within government departments where the technology is now practical and economic.

A listing of the specific responses is included in Appendix C.

C. Recommendations For Future Surveys

The major reason for non response was quoted as "the time needed to fill out the figures on the questionnaire". It is recommended that a detailed questionnaire survey be utilised only every three years with the intermediate years being a much simpler, more basic form which would track only those main items which would include the following:

A. Total activity in dollars and watt peak
B. Export versus Canadian sales percentages
C. Profile of firms by activities
D. Government versus private sales by dollars
E. Regional distribution of sales in dollars

It is recommended that a review of the survey targets be made in conjunction with the TAG (Technical Advisory Group) and the Canadian Photovoltaic Industries Association (C.P.I.A.) for a long term survey plan with a ten year range. The results of this plan should be distributed as early as possible, before the next major survey so that the firms can structure their reporting and recording procedures appropriately.

It is recommended that an annual survey be conducted in the spring time with response deadline the end of April, so that the results can be reported at the annual C.P.I.A. meeting in June.

The figures resulting from these surveys are most important to the industry participants as well as to the government ministries. It is recommended that the surveys continue on an annual basis, but with detailed extended survey questionnaires being utilised only every third year.

I. References

1.Photovoltaic Insiders Report (PVIR) August 1989 pg 6

2.PVIR MAY 1990 add.

3.PVIR AUG.90 pg1

4.PVIR Aug.90, pg1

5.PVIR July 90 pg1

6.PVIR Feb. 91 p6
7.PVIR Dec.90 pg 1
8.PVIR Sept 89 pg 2
9.PVIR Aug.89 pg 2
10.PVIR Dec89 pg 1
11.PVIR Oct.90 p 5
12.PVIR Aug 89 pg 5
13.PVUR Nov.89 pg2
14.PVIR Oct.89 pg 2
15.PVIR Mar 90 pg 3
16.PVIR June 89 pg 1
17.PVIR Jan 90 pg 3
18.PVIR Jan.90 pg 4
19.PVIR Jan 89 pg1
20.PVIR Aug 89 pg6
21.PVIR Aug.89 pg 4
22.PVIR May 89 pg 6
23.PVIR May 89 pg add

24.PVIR June 89 pg 6
25.PVIR July 89 pg add
26.PVIR Oct.89 pg4
27.PVIR Dec.89 pg 5

APPENDIX A

- List of Participants Surveyed 1989
- List of Participants Surveyed 1988

LIST OF FIRMS SELECTED FOR MAIL-OUT SURVEY ON 1989 COMMERCIAL ACTIVITY OF THE PV INDUSTRY

1. Provincial Consultants
   St. John's, Nfld.

2. Sun Ross Solar Systems
   Port Hawkesbury, N.S.

3. Vincent A. MacDonald
   Stellerton, N.S.

4. Robinson Illumtech Consulting
   Liverpool, N.S.

5. Ronde Point Foreste
   Normandin, Que

6. Groupe Uni-Spec
   Chicoutimi, Que

7. Batteriee Specialilte
   Chicoutimi, Que

8. Geneq Inc
   Montreal, Que

9. Intersolar Canada
   Montreal, Que

10. Silonex
    Montreal, Que

11. Argus Telecom International
    St. Laurent, Que

16. Bestek Micro Devices & Systems
    Ottawa, Ont

17. Mayerson Solar
    Orleans, Ont

18. Passmore Associates Int'l
    Ottawa, Ont

19. Darentek Corp
    Ottawa, Ont

20. Mechron Energy Systems
    Ottawa, Ont

21. Intelcan Technosystems Inc.
    Nepean, Ont

22. AstroPower Canada
    Nepean, Ont

23. Adkinson & Associates
    Beamsville, Ont

24. Intersolar Group Canada
    Beamsville, Ont

25. Lenbrook Industries
    Pickering, Ont

26. Prometheus Energy
    Concord, Ont

12. Reonac Energy Systems Inc
St. Laurent, Que

13. Energie Alernative
Mandala
LaPatrie, Que

14. ESI Multi Measures
Richelieu, Que

15. Thermax Canada Ltd
Vankleek Hill, Ont

31. Sun Volts Unlimited
Don Mills, Ont

32. Contra/Entropy Co. Ltd
Lion's Head, Ont

33. Tds Dixon
Kitchener, Ont

34. Kerr Solar Systems
Chatham, Ont

35. Northern Lights Energy
Richards Landing, Ont

36. Solarquip H.S. Limited
Richards Landing, Ont

37. Northern Lights
Atikokan, Ont

38. Tarryal Solar Systems
Keewatin, Ont

27. Ortech International
Mississauga, Ont

28. Solarpac Development
Corp
Mississauga, Ont

29. Westrock Battery
Hamilton, Ont

30. Westinghouse Canada
Hamilton, Ont

47. Canadian Agtechnology
Partners
Olds, Alta

48. Westronic Inc
Calgary, Alta

49. Dirk and Price Eng.Ltd
Calgary, Alba

50. TransAlta Utilities Corp
Calgary, Alta

51. Solar Innovations
Calgary, Alta

52. Nor'Wester Energy
Systems
Calgary, Alta

53. Norther Unconventional
Edmonton, Alta

54. Howell Mayhew Engineer Inc
Edmonton, Alta

39. Battery Doctor
Sudbury, Ont

40. Lawson Enterprises
Elliot Lake, Ont

41. Bills Business Machines
Thunder Bay, Ont

42. Photovolt Electric System
Winnipeg, Man

43. Westrock Battery
Winnipeg, Man

44. Kelln Consulting Ltd
Lumsden, Sask

45. Laymen Sales
LaRonge, Sask

46. Photron Canada, Inc
Colinton, Alta

55. Northern Alternate Power Systems
Pink Mountain, B.C.

56. Appropriate Energy Systems
Chase, B.C.

57. Sun Trap Electric
Smithers, B.C.

58. B.C. Solar/Canada
Horsefly, B.C.

59. Energy & Building J.C. Inc
St Amable, Que

60. Energy Alternatives
Lasqueti Island, B.C.

61. Softech Solar
Vancouver, B.C.

62. Ward & Associates
Vancouver, B.C.

63. Tideland Signal Canada
Richmond, B.C.

64. Soltek Solar Energy Ltd
Victoria, B.C.

65. Les Entreprises Energie Plus
Hull, Quebec

EXHIBIT I-1

LIST OF FIRMS SELECTED FOR MAIL-OUT SURVEY (1988)

ON COMMERCIAL ACTIVITY OF THE PV INDUSTRY

1. Contra/Entrophy Company Ltd.
   Lyons Head, Ontario
2. Prometheus Energy
   Concord, Ontario
3. Tideland Signal Canada Ltd.
   Burnaby, B.C.
4. Leonard Electric Ltd.
   Mississauga, Ontario
5. Mechron Energy Systems
   Ottawa, Ontario
6. Mayerson Solar Sales
   Orleans, Ontario
7. Seastar Instruments
   Sidney, B.C.
8. Argus Telecom International Inc.
   St. Laurent, Quebec
9. Geneq Inc.
   Montreal, Quebec
10. Lenbrook Industries
    Pickering, Ontario
11. Photron Canada
    Colinton, Alberta
12. Westronic Inc.
    Calgary, Alberta
13. Intersolar Group Canada
    Pickering, Ontario
14. Soltek Solar Energy
    Victoria, B.C.
15. Global Thermoelectric Power Systems
    Calgary, Alberta
16. Bestek Micro Devices & Systems
    Ottawa, Ontario
17. Solace Micropower Engineering Ltd.
    Vancouver, B.C.
18. Solarpac Energy Systems
    Mississanga, Ontario
19. Silonex Inc.
    St. Laurent, Quebec
20. Ken Solar Systems
    Chatham, Ontario
21. Solar Quip Heating Systems Ltd.
    Richards Landing, Ontario
22. Astropower Canada
    Nepean, Ontario

APPENDIX B

Copy of 1989 Questionnaire

CANADIAN PHOTOVOLTAIC INDUSTRIES ASSOCIATION
3-15 YORK STREET, OTTAWA, ONTARIO, K1N 5S7 TEL: 613-236-4041 FAX: 236-5053

PRIVATE AND CONFIDENTAL **EMR/EPC # 161-03456**

COMMERCIAL ACTIVITY IN PHOTOVOLTAICS

NAME _____

ADDRESS _____

TELEPHONE _____

Note to Respondent

The attached condensed questionnaire aims at eliciting information pertaining to the commercial activity in Photovoltaics in Canada. Please note that the data on your firm's activity in Photovoltaics will be treated in strict confidence by the Peat Marwick Stevenson & Kellogg. Only aggregate information pertaining to the Photovoltaic industry in Canada will be made available to CPIA and the Department of Energy, Mines and Resources.

This is a follow up to the survey and report of 1989 by Peat Marwick Stevenson & Kellogg for Energy Mines and Resources, copies of which may be obtained on request.

We hope, that through your cooperation and participation in this study, we will be able to provide the Government of Canada with further current information relevant to making policy decisions with respect to the Photovoltaic industry.

Please note that your participation in this survey, which is entirely voluntary, would be valuable to the future programming decisions of the Department of Energy, Mines and Resources as well as the Canadian Photovoltaic Industries Association.

For purposes of timely completion of this study we would very much appreciate your responses no later than November 15, 1990. On receiving your response we will carefully analyze and estimate the extent of commercial activity in Photovoltaics in Canada.

Should you have any questions regarding the questionnaire, please contact either of the following individuals.

Jimmy Royer
Solar Energy
Development Group
Energy, Mines and Resources
480 Booth Street
Ottawa, Ontario, K1A 0E4
613-996-6079

Stephen Andrew
Peat Marwick Stevenson
& Kellogg
21 Floor Tower B, Place de Ville,
112 Kent Street
P.O. Box 2530 Station D
Ottawa, Ontario, K1P 5W6
613-787-3700

October 1990

I.2 Could you describe your manufacturing, distribution / retailing/ wholesaling and assembly activities in the context of each of the following characteristics. Please answer for the activities which are applicable to your firm.

Activity	Characteristics	Description
Manufacturing	What items are manufactured?	
	What inputs go into the activity? (eg imported modules, partly assembled systems, complete systems packages, expertise, technology, manufacturing, facility,etc.)	
	Where are your key suppliers (specify country)?	
	On average, for the year 1988-89 What percentage of your sales for this activity was from exports?	% of total dollar sales
	What countries do you export to (directly & indirectly)?	
	On average, for the year 1988-89, what percentage of your firm's domestic sales of manufactured items was to:	%of total dollar sales
		Distributors
		Dealers %
		Wholesalers %
		Users (direct installation) %
		Others (specify) %
		TOTAL 100%
	What percentage of your firm's total revenues are obtained from manufacturing?	% of total revenues

Activity	Characteristics	Description
Distribution/ Retailing/ Wholesaling	What items are distributed retailed or wholesaled?	
	What inputs go into the activity? (eg imported modules, partly assembled systems, complete systems packages, expertise, technology, manufacturing, facility, etc.)	
	Where are your key suppliers (specify country)?	
	On average, for the year 1988-89 what percentage of your sales for this activity was from exports?	% of total dollar sales
	What countries do you export to (directly & indirectly)?	
	On average, for the last year 1988-1989, what percentage of your firm's domestic sales (other than manufactured or assembled items) was to:	% of dollar sales Manufacturers % Distributors % Retailers % Wholesalers Users (direct installation) % Others (specify) % TOTAL 100%
	What percentage of your firm's total revenues are obtained from distribution/ retailing/wholesaling?	% of total revenues

Part II

COMMERCIAL ACTIVITY IN PHOTOVOLTAIC PRODUCTS

The main purpose of this section is to analyse and assess the extent of commercial activity in Canada in Photovoltaic products. Despite the tediousness of the exercise, we request you to fill out the data necessary to make this study a success. If your accounting system does not gather a specific type of data, please estimate the required data item to the best of your ability. Wherever the data are estimated please make sure to add an asterisk (*) beside the estimated item.

For your convenience in filling out these forms we have divided them into three sections.

Section A deals with complete systems packages

Section B deals with modules outside those contained in complete systems packages.

Section C deals with BOS (Balance of System) Equipment.

Summary of Sales

Form 1. For the three sections identified below, please provide a breakdown of your firm's sales for 1988-89. If you have no sales in any section leave it blank.

Applications *	A Systems			B Modules			C B.O.S. Components		
	No.of systems	$	Total Wp**	No.of Modules	$	Total Wp**	batteries $	power conditioning Equip $	other B.O.S. $
Communications									
Monitoring/Sensing Equipment									
Residential Use									
Laboratory Test									
Retail Use Corrosion Protection									
Remote Lighting									
Water Pumping									
Community Power									
Medium Load Center Industrial/Commercial									
Residential Grid Connect									
Other (specify)									
TOTAL (All applications)									

* Communications includes radio and repeaters; Monitoring/Sensing Equipment includes water level monitor, environmental monitor, seismic monitor, RTU and radio counter; Residential Use includes home power and roof fan; Laboratory Tests includes commercial and educational applications; Corrosion Protection includes oil & gas related and bridges applications; Remote Lighting includes railway/signal related applications.

** Wp = Peak Watts. If you use kilowatts please specify on each entry.

FORM 2

How would you breakdown the total sales of each section reported in Form 1 (last line) into the following categories of sales?

Categories	Percentage of Total $ Sales by Section		
	A. Systems	B. Modules	C. B.O.S. Components
Manufactured in Canada and installed in Canada	%	%	%
Manufactured in Canada and installed Abroad	%	%	%
Manufactured Abroad and installed in Canada	%	%	%
Imported and re-exported	%	%	%
TOTAL	100%	100%	100%

FORM 3

For the PV Equipment you sold for installation in Canada, please provide a regional distribution .

Region	Percentage of Total $ Sales by Section		
	A. Systems	B. Modules	C. B.O.S. Components
Atlantic	%	%	%
Quebec	%	%	%
Ontario	%	%	%
Prairies	%	%	%
British Columbia	%	%	%
Northwest Territories	%	%	%
Yukon	%	%	%
TOTAL	100%	100%	100%

FORM 4

For the PV Equipment sold for installation in Canada, could you please provide a distribution of total sales and peak wattage by type of purchaser.

Type of Purchaser	A Systems		B Modules		C B.O.S. Component
	$	Wp*	$	Wp*	$
Federal Government	%	%	%	%	%
Provincial Government	%	%	%	%	%
Utilities/Regulated Industries	%	%	%	%	%
Research Educational	%	%	%	%	%
Private Sector	%	%	%	%	%
Total	100%	100%	100%	100%	100%

*Wp = Peak Watts. If you use kilowatts please specify on each entry.

PART III

IMPORTANT ISSUES AND TRENDS AFFECTING THE CANADIAN PHOTOVOLTAIC INDUSTRY

The Department of Energy, Mines and Resources is interested in your company's views concerning key issues and important trends in Photovoltaic technology, in world markets and in government policy as it relates to the Photovoltaic industry in Canada.
In the spaces provided below, we would appreciate your comments concerning each of these three areas. Please attach separate sheets should you require additional space.

III.1. In your opinion, what important trends in Photovoltaic technology development are or should be of interest to Canada and the Canadian Photovoltic industry?

_____
_____
_____
_____

III.2. What are the important trends/issues influencing the development of world markets for Photovoltaic products and systems, and what implications/opportunities do these represent for Canadian industry?

_____
_____
_____
_____
_____

III 3. Based on your observations in III.1 and III.2, above, what are the implications for public policy making with respect to Photovoltaic industry development?

_____
_____
_____
_____
_____
_____

We thank you very much for participating in this survey. Aggregate results will be presented to you. Our methodology includes a telephone follow-up and an expert panel discussion. With your help we look forward to being able to provide a continued sound analysis of Canadian commercial activity in Photovoltaics.

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CANADIAN PHOTOVOLTAIC INDUSTRIES ASSOCIATION
3-15 YORK STREET, OTTAWA, ONTARIO, K1N 5S7
613-236-4041 Fax 236-5053

FAX TO: THE PRESIDENT

FROM: ALEXA J. PRITCHARD

DATE: FEBRUARY 19, 1991

NO. OF PAGES: 11

In October your company was sent a request to participate in a Photovoltaic Commercial Review for the Department of Energy, Mines and Resources. To date, no response has been received by Peat Marwick Stevenson & Kellogg.

Due to the volume of sales we believe you have had in 1988-89, your input is essential for the Department's policy decision making with respect to the Photovoltaic industry. Your participation could benefit you and your company in the long run.

We ask that you take time now to complete the attached duplicate form and return it immediately to the Accounting Firm of:

Peat Marwick Stevenson Kellogg
21st floor Tower B Place de Ville
112 Kent Street OR
P.O. Box 2530 Station D
Ottawa, Ontario K1P 5W6

If you have any questions concerning the questionnaire, please contact Stephen Andrew or Eva Tom of PMSK 613-787-3700
Fax 238-3698. You may also contact me, however, CPIA does not have access to the information you provide. IT IS STRICTLY CONFIDENTIAL

WE MUST HAVE THIS SURVEY COMPLETED BEFORE THE END OF THE GOVERNMENT FISCAL YEAR. PLEASE IF YOU CAN NOT GIVE US ACCURATE FIGURES, PLEASE DO YOUR BEST TO ESTIMATE, INDICATE ESTIMATED.

IF YOU DO NOT WISH TO PARTICIPATE, PLEASE INDICATE ON THIS FAX AND SEND IT TO EVA TOM AT PMSK ASAP

APPENDIX C

- Peat Marwick Report on Comparison with 1988
- Qualitative Responses Received

*Comparison Of Overall Commercial Activity In Photovoltaics For The Years 1987-1988 And 1988-1989 **

1988-89 survey results were consolidated, and judgemental extrapolations based on industry knowledge were undertaken to compensate for non-responses. The approach taken was similar to that used to derive the 1987-88 results, with extrapolations being made for the eight key companies that responded to neither survey. However, a conservative view has been taken by not extrapolating to the 38 non-respondents surveyed for the first time in 1988-89, as too little was known about them. A comparison of the results taking the above approach indicates that the Canadian PV industry increased its revenues in 1988-89 over the previous year by approximately $1.9 million, a 13.6% to 14.6% increase over estimated 1987-88 revenues in the $13 to $14 million range.

A comparison of the overall commercial activity in the Canadian photovoltaic industry for the two years indicates:

- Significant growth in the revenues of 3 companies and some growth in the revenues of 1 other. On the other hand, some companies went out of business or had lower revenues in 1988-1989.

- The combined revenues in 1988-89 of only those companies that responded to the 1987-88 and 1988-89 surveys was, in total, $3.4 million less than in 1987-88.

- The 1988-89 survey, sent to 65 companies rather than the 22 surveyed in 1987-88, has identified new players in the industry. These new participants reported revenues of approximately $5.3 million in 1988-89.

Although the number of responses increased in 1988-89, the response rate still represents a problem in terms of the level of confidence that can be ascribed to the results. The level of incomplete as well non-responses requires extrapolations that, of necessity, assume there is no significant non-response bias. That is to say, the performance of non-respondents is, on average, similar to that of respondents. Greater certainty as to the precision and accuracy of results can only be obtained if all key industry players respond fully, and a higher proportion of other companies participate in any future surveys.

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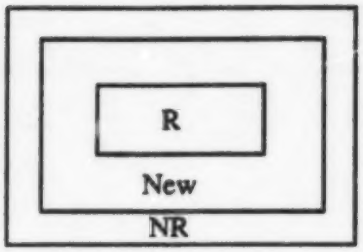
* *Comparison based on respondents who answered either or both surveys, as well as knowledge of industry participants' profiles and extrapolations for incomplete or non-responses to either survey.*

Photovoltaic Study

Re: Estimating The Percentage Change In Revenues 1987-88 to 1988-89



R=Respondents to both surveys
New Respondents to 1988-1989 survey
NR=Non-respondents to both surveys.

Respondents to 1987-88
+
1988/89

Sales lower by $3.4 M

New Respondents to 1988-89 }

$5.3 (sales activity not included in 1987-88 survey).

Non-respondents estimated at $5-6M in both 1987-88, 1988-89.

Estimated PV revenues in 1988-89 are $1.9M higher than 1987-88.

$\frac{1.9M}{13M}$= 14.6% higher than $13M revenues (lower end of range of 1987-88)

$\frac{1.9}{14M}$= 13.6% higher than $14 M revenues (upper end of range of 1987-88)

To be exact, 1988-89 revenues are $14.9M-15.9M, i.e., 13.6% to 14.6% higher than the $13-$14M revenues for 1987-88.

(#5)

CPIA - Comments for Part III

QIII.1: What important trends in Photovoltaic technology development are or should be of interest to Canada and the Canadian Photovoltaic industry?

Survey #	*Comment*
1	Niche markets present themselves in the areas of storage and high-efficiency appliances/loads. These factors may have as large an impact on implementation of PV technology as cost reductions in PV modules.
2	New trends towards low cost production of polycrystalline silicon wafers and cells. Hybrid technology being demonstrated to be cost effective. PV use in automobiles creates potential for Canadian Manufacturers.
6	Hybrid power systems (PV, diesel, wind); use of microprocessor controls; multi-junction amorphous silicon solar cells; thin film crystalline solar cells.
7	Delay in development to commercialization of their film technology extends viable lifetime for silicon production opportunities.
9	The lack of Canadian made products makes it very likely that most of the benefits for increasing sales in Canada and the world will flow outside Canada.
11	Due to the increasing cost of energy, small scale systems such as street lighting or exterior building lighting should be advanced for the public to see.
12	Potential for significant job creation/export of Canadian systems worldwide.
14	Grid connected systems issues; new thin film technology for solar cells.
15	Establishment of PV Electrical Code; certification of modified sine wave inverters for remote residential applications.
16	Hybrids, higher efficiency.
18	Property designed and inspected installations are key to assuring that the systems being sold will work and be safe.
19	Support research in universities, or industries to get new products which will help Canadian manufacturers to be more competitive.
20	Lower $/watt - CSA approval of DC-AC power inverters - Canadian made modules, BOS components.
21	Practically every country in Europe, Asia and South America place more importance in the development and application of photovoltaics than does Canada.

QIII.1: (cont.)

Survey #	*Comment*
22	Comment at the bottom of the page: As a new dealer of less than 1 year, I really haven't formed any "global" opinions on the industry. My only comment is that the vast majority of my potential customers still see this industry as a "fly by night happy from hell approach" and need to be re-educated.
23	Emphasis should be on small systems, low cost applications. No more mega projects show case please.
24	Applied research to replace fossil fuel.
26	PV is a relatively new, uncommon technology - many people are completely unaware of its availability and performance benefits. Documented evidence shows that existing users are pleased, on the whole, with PV cost benefits performance in a market driven economy (no subsidies).

QIII.2: What are the important trends/issues influencing the development of world markets for Photovoltaic products and systems, and what implications/opportunities do these represent for Canadian industry?

Survey #	*Comment*
1	Other countries are making a concentrated effort to develop PV. Canadian industry, with support of government, must identify places in the market where they can compete and meet a need not supplied/supported by much larger commitments in $ of other countries.
2	Instability in Middle East - increases in oil prices. Concern for the environment. Demonstration that PV is cost effective in many applications. Leads to larger market/increased interest in PV.
6	Increasing need for public telephones - more marketing. Need for dependable, low maintenance electricity at village level, more marketing, financial aid, demonstration systems.
7	Environmental concerns ie, fossil fuels encourages use of PV CEC support for PV water pumping in Africa.
9	Concerns for the environment and costing of conventional fuel to reflect their environmental impact.
10	Levels of research and development in Europe and Japan in PV. Interest in reducing greenhouse gas emissions and the role that PV can make as we reduce these emissions.

QIII.2: (cont.)

Survey #	*Comment*
11	The Canadian Industry should be actively trying to sell in the Eastern European countries who will sooner or later try to 'jump ahead' using advanced technology.
12	Environmental (greenhouse effect); fuel scarcity and costs; Canada could be a world leader in practical applications of PV systems in developing countries.
16	Greenhouse effect.
19	Third World, remote communications and summer homes. With our large territory and only a small part of it with high density of population, Canadian industry has the best opportunities for photovoltaic systems.
20	Price and availability of oil in 3rd world.
21	Educating the Canadian consumer and giving them incentives to buy and use photovoltaic power systems is of utmost importance. The burning of fossil fuels to make electricity must be replaced by energy alternatives. The primary source for this is photovoltaics.
23	Every elected politician should declare his/her platform on solar and be monitored for his/her delivery on promises.
24	Insufficient information, high cost of equipment to the individual or the consumer.
26	We are not knowledgeable about world markets.

QIII.3: ***Based on your observations in III.1 and III.2 above, what are the implications for public policy making with respect to Photovoltaic industry development?***

Survey #	*Comment*
1	With limited funds available, government must be very specific and direct in identifying the results they wish to achieve. PV modules, we should take advantage of their inattention to the areas mentioned above and utilize our skills to solve other pieces of the efficiency puzzle. This becomes technology that Canadian industry will have a 'head start' in and can, therefore, compete on the manufacturing level. There is no use in throwing limited $ away trying to 'follow' the rest of the world. We are better off if we 'lead' in certain niche areas.

QIII.3: (cont.)

Survey #	*Comment*
2	Environmental issue should drive government policy towards support of PV, since it has least environmental cost. Demonstration of cost effective applications show that PV can make significant impact on energy scene. Government should build PV into policy as a preferred energy option. Industry will grow with government commitment.
6	Support deployment of hybrid power systems for remote small communities to show benefits of solar energy in developing world, improve quality of life at village level and provide electricity for cottage industries.
7	Support for production of solar grade silicon. Develop internal programs to encourage use of PV generation in Federal Ministries.
8	I believe the most important issue to the PV industry is to require all utilities to use net billing on interconnected systems. Assistance for equipment manufacturers to acquire CSA approval.
9	Policy should encourage the development of "Made in Canada" products and a Canadian field of expertise. (Would like to participate on the expert panel)
10	Policies should be developed which keep the PV industry very well informed about world developments and keep them well connected with the groups in Europe, Japan, and the USA which are abreast of these developments. In this way we will always be keeping ourselves on the lookout for market and technology opportunities.
11	"Money", the high cost of these items is one of the only road blocks in selling these systems.
12	Encourage private sector to fully test power PV products prior to export. Support test centers for commercial systems (separate from academic and basic researching) need practical field scale testing. ie: Lethbridge test site could easily do more PV evaluation re pumping systems.
18	The Government needs to be shown the economics of some of these systems and in the end start using at least the ones that are economical.
19	Low cost and smaller area to get more power are the keys for new markets.
20	So far so good, but a need to focus in on long term goals is needed with joint ventures and input from lending agencies ie, CIDA, World Bank, and East countries.

QIII 3: (cont.)

Survey #	*Comment*
21	If an equal number of taxpayers' dollars were spent by the Federal and Provincial Governments as incentives and grants to consumers to buy and install photovoltaic power systems, that are spent or given to the petroleum and nuclear industries in Canada. The growth of photovoltaic power use would be practically limitless in Canada, would not degrade our environment, nor have the potential to harm anyone.
23	There is no long term Government commitment in PV like in Europe and Japan. PV should be tax exempt and receive conversion incentives like propane.
24	Encourage growth of photovoltaic use by removing all taxes from photovoltaic equipment.
26	Federal Government support (RD&D, tech transfer etc.) for PV (renewables in general) has fallen sharply since the early 80's (USA also). For emerging, uncommon technologies such as PV, this support and associated credibility is crucial. Funding levels should be restored. Therefore, in the short term and long term, tech transfer and demonstration projects are very important. (Re: tax incentives - to be fair, if PV deserves this, all renewables do also).